to think. Compare, as products of these opposite types of mental training, Darwin and Huxley with devout Mohammedan and Hindu ecclesiastics. The evidence in favour of scientific education is enormous, decisive, indisputable, but it lies outside the sphere of botany and zoology, in psychology and history. By whatever rational standards we judge human communities—material or intellectual progress, efficiency in peace and war, wealth, enterprise, energy, the production of great thinkers and men of action, civil war, brigandage, murder and other crimes, and so on—we find invariably that the societies the mental training of which has most nearly approached the scientific ideal are the superior. Compare the results of the mental training given by Socrates and his fellows to the ancient Greeks with that given by the Russian popes to their victims. Many nations (*e.g.* the Romans) have fallen because a change for the worse in mental training left descendants too inefficient to preserve that which better-trained ancestors had secured. Many nations (*e.g.* after the Reformation) have arisen because improved mental training enabled them to surpass competitors. Consider the late war and how completely the more biassed peoples have been smashed. But this is a subject too vast for present consideration; I have tried to deal with it elsewhere.[1]

I may be right or wrong as to the conclusions I have reached, but clearly the evidence and problems I have instanced exist. Clearly they are matters for biology, although they have been neglected by her.

Academic biology is of little account in the world. The hobby of some naturalists who use not a tittle of the evidence available, she possesses next to no established truth. Her few students are engaged in unending disputes, all of which are consequent on a misuse of words or a neglect of crucial testing. Her indefensible terminology separates her from a host of subsidiary sciences. But a biology clarified and simplified by a precise terminology, and in possession of a classification of characters similar to that employed in other studies, might easily become the queen of sciences. A few wide generalisations accepted by everyone would then replace the present chaos of opinions, and provide a basis for work of practical utility. The use of evidence from other studies would make their students her own. So strengthened, she would become a power in the land, and perhaps lay the foundations of that golden age of science and human wisdom and well-being of which we all dream.

Surely there are biologists who perceive that the failure to establish truth can have no cause other than lack of right scientific method, and who are prepared to substitute the method of discussion which has created other sciences for that of controversy which has wrecked biology.

G. ARCHDALL REID.

Magnetic Double Refraction of Smokes.

THE interesting discovery recorded by Sig. Tieri in NATURE of August 18, p. 778, that the fumes from an iron arc can, when subjected to the action of a magnetic field, rotate the plane of polarised light, is in close accord with the view of the structure of such fumes advanced by Prof. Elihu Thomson in his recent letters to NATURE, and agrees also with the observation of Mr. Speakman and myself (see NATURE, June 23, p. 520; and July 14, p. 619).

Prof. Thomson explains the sudden enhanced luminosity of the light scattered by the iron oxide smoke when the magnetic field is applied by the particles arranging themselves along the lines of force. For this structure to be effective the particles cannot be spherical, but must consist of rods or chains, for only then would the intensity of the reflected or scattered light vary with "end on" or "length on" incidence. This was confirmed by a microscopic examination of the iron oxide fume, which showed the particles to consist of short strings or chains of roundish beads not touching one another.

The experience of Mr. Speakman and myself is that the fumes from metallic arcs in air undergo rapid changes with time. The minute particles produced at first by condensation of vapour aggregate together to form complexes, which often show a definite chain-like structure when examined after deposition on a slide, but in the air are continually altering their form under molecular bombardment.

Now it seems likely that if by magnetic or electric forces the small chains or strings can be made to space themselves with their axes all in one direction, not only will the effect described by Prof. Thomson be produced, but a beam of polarised light traversing the fume at right angles to the field of force would suffer rotation provided that the plane of polarisation is neither parallel nor at right angles to the longer axes of the small chains. This is just what Sig. Tieri finds, and it might be expected further, if the above explanation is the correct one, that the magnetic double refraction would vary with the age of the smoke and its method of production. The bluish-coloured smoke found by Prof. Thomson to accompany the yellow fumes from the iron arc, and which did not exhibit the magneto-optical effect, consisted probably of single particles, and would be unlikely to show magnetic double refraction. It corresponds with the initial stage of the oxide clouds we have studied before agglomeration has had time to occur.

This striking behaviour of iron oxide dispersed in air discovered by Sig. Tieri exhibits a close parallel to the behaviour of the same substance dispersed in water. Cotton and Mouton and others have investigated the magnetic double refraction of iron oxide hydrosol, and they ascribe the effect to the orientation of rod-shaped or lamellar ultramicrons. Further, the magnitude of the effect was found to increase as the colloid became coarser.

A continuation of the work commenced by Sig. Tieri may well lead to much interesting information on the form of the particles in smokes.

R. WHYTLAW-GRAY.

Eton College, Windsor, August 21.

The Contractile Vacuole.

IN connection with previous correspondence on the mode of production of the contractile vacuole in Protozoa (NATURE, vol. cvi., pp. 343, 376, 441), I find that it is, in point of fact, Prof. Marcus Hartog to whom the credit of the osmotic view is to be given. In a communication to the British Association in 1888 (Rep., p. 714) this observer pointed out that, owing to the semi-permeable surface membrane, substances in solution in the protoplasm of these organisms must attract water, which accumulates at a particular spot until it reaches the surface, breaks through the membrane, and escapes. The membrane spontaneously closes up as the distension is relieved. Prof. Hartog shows that if substances such as sugar or potassium nitrate are dissolved in the outer water to a sufficient osmotic concentration, the production of the vacuole ceases. The paper was reprinted in Ann. Mag. Nat. Hist., Sec. 6, vol. iii., p. 64 (1889). The theory was worked out in more detail by Degen (*Bot. Zeit.*, vol. lxiii., abt. 1, 1905), and is explained by Prof. Hartog in his article on Protozoa in the Cambridge Natural History (1906),

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[1] *Vide* "Prevention of Venereal Disease," reviewed in NATURE, April 14.

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p. 15. My knowledge of Stempell's paper was derived from an abstract in which the osmotic aspect was chiefly emphasised. On reference to the original I find that this part of the process is obscured by a number of complicated subsidiary hypotheses. W. M. Bayliss.

University College, London.

A Correction.

Some months ago Sir Ray Lankester was good enough to write to me in regard to the statement in my "System of Animate Nature" (1920) that he had spoken of evolution as "a chapter of accidents." He asked me to verify the quotation, and I thought I had only to turn to my book-shelves for a minute to find the passage. But in spite of some months of very agreeable and profitable re-reading of Sir Ray Lankester's writings, I have *failed* to verify the quotation, and the only thing to do is to apologise. Perhaps I should have seen that the phrase I ascribed to Sir Ray Lankester was inconsistent with such sentences as these:—"Thus then it appears that the conclusion that Man is a part of Nature is by no means equivalent to asserting that he has originated by 'blind chance'; it is, in fact, a specific assertion that he is the predestined outcome of an orderly, and to a large extent 'perceptible,' mechanism" ("The Kingdom of Man," p. 9); and "They [the mental qualities which have evolved in Man] justify the view that Man forms a new departure in the gradual unfolding of Nature's predestined scheme" (*op. cit.*, p. 25).

I yield to no one in my appreciation of the services which Sir Ray Lankester has rendered to zoology and biology, and I can only express my regret that in a busy life I made a mistake which amounts to an unintentional misrepresentation.

J. Arthur Thomson.

Natural History Department, Marischal
College, University of Aberdeen, August 16.

Wrightson's Hypothesis of Audition.

The hypothesis advanced by the late Sir Thomas Wrightson in his book "An Enquiry into the Analytical Mechanism of the Internal Ear" has, it would seem, received such wide acceptance that the following comments upon it may be of interest.

Wrightson suggested that the appreciation by the ear of the constituent notes in a musical chord is due to the recognition and measurement by the brain of certain time intervals, which occur between the changes in motion of the air when it is transmitting music. In proof of this suggestion Wrightson gives graphic examples. First he takes two simple sine curves representing two musical notes, and from them he obtains a third curve which shows the motion of the air when both notes are sounding together. On this compound curve he marks distances between crests, troughs, and crossing points which are equal to the wave-lengths of the two separate notes.

From the identity of these distances Wrightson concludes that when the observer appreciates the constituent notes in a chord he does so by recognising the existence of these time relationships.

I find, however, that this proof loses its value, since it can be shown by trial that purely arbitrary wave-lengths are also represented in the compound curve as frequently as are those of the notes actually present.

It is scarcely possible, therefore, to accept Wrightson's explanation of the power of analysis possessed by the ear, since, all wave-lengths being equally represented, there is no criterion by which the right notes can be recognised and the arbitrary ones excluded.

This criticism, considered in conjunction with that of Boring and Titchener (*American Journal of Psychology*, vol. xxxi., 1920, pp. 101–13), would seem to take from Wrightson's theory almost all the essential features which individualise it from the older telephone theory of Rutherford. H. Hartridge.

The Generation of Heath-fires.

It is the general practice to attribute the heath-fires which have been so common of late to the careless dropping of matches or to the camp-fires of picnic-parties. But this is not always the cause. An instance came under my notice during the late hot weather which seems to be worth recording. I was walking along one of the ridges at Finchampstead, Berks, and to the south was a fairly steep slope of peaty heath land, giving rise here and there to clumps of bracken, but exposed each day to the sun's rays for many hours at a time. Noticing some smoke emerging from the soil, I turned down the slope to stamp out a possible fire, and I found that as soon as it was put out in one place it emerged elsewhere, a foot or so away. My companion and I repeated the process in many places, but soon we saw that the smoke was emerging from a hundred places, and our efforts were useless. Smoke was rising out of the peaty soil over an area of at least a quarter of a square mile, and another hour of the sun's heat might have been sufficient to result in the place breaking into flame.

From a note in Nature of January 27 last, p. 704, in regard to the spontaneous burning of coal-seams in the United States, I see that the fine dust of lignite may ignite at 150° C., and I suggest that in the case in point the finely divided carbonaceous soil may have been undergoing such changes under the heat of the sun, which may have brought up the temperature to something approaching this. Anyway, here was a considerable area smoking under the intense heat, and ignition could not have been far off. Edwd. A. Martin.

South Norwood, S.E., August 13.

Cornalith.

In the *Bulletin of Agricultural Intelligence* issued by the International Institute of Agriculture, just to hand, there is a précis of an article in the *Annales de Gembloux* under the heading "Plastic Materials with a Casein Basis: Galalith and Cornalith." The latter word is not in the N.E.D. or in the recently published "Dictionary of Scientific Terms." Galalith, or "milk-stone," is well known, and cornalith will be "horn-stone." The first sentence in this précis reads: "Galalith and cornalith, two substances made from casein that has been treated with formalin, are produced now in various countries, especially in France, where there are already several factories."

It is stated that, in order to diminish the cost of opaque articles made from casein treated with formaldehyde, the raw material is sometimes mixed with the refuse of horns, horsehair, and other nitrogenous matter. When this is done is it called "cornalith," and, if so, does the name or term correctly describe the material?

It is also stated that attempts have been made to use vegetable casein extracted from soya beans, as being less expensive than casein obtained from milk. Has this been successfully accomplished, and, if so, can the resulting plastic material be called "galalith," or is some other term used? R. Hedger Wallace.

August 16.

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